

The quality of certification of deaths due to external causes in the city of Fortaleza in the State of Ceará, Brazil

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Abstract *The article analyzes the quality of information of deaths from external causes in Fortaleza, in the State of Ceará, Brazil. They analyzed the completeness of the information of the death certificate (DO) and the correlation between the underlying cause of death described in the OF and registered in the Mortality Information System (SIM). We used all the original statements of deaths from external causes, occurred in 2010, of residents in Fortaleza. The study population was 2109 DO. The statements were individually checked seeking to identify the completion of the fields and the basic cause attested the coding of the underlying cause in this DO and compared with the SIM was held. The fields with the highest completion rates were: name (100%), place of residence (100%), mother's name (99.6%), place of birth (99.1%), and sex (98.8%). The fields with the lowest completion rates were: place of occurrence (55%), race/skin color (38.4%), and schooling (34%). They observed inadequacies in the completion of the underlying cause. In DO are reported injuries found and not the circumstances of the death. There was poor level of concordance between the basic cause of DO and registered on the SIM (κ 0.07). They suggest awareness strategies and training of medical examiners.*

Key words *Death certificates, Mortality Information System, External causes, Vital Statistics*

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Introduction

Deaths due to external causes are a serious health problem due to their magnitude and the resulting social and economic impacts¹. There are a number of social determinants of violence in Brazil. Rates of mortality due to homicide and traffic accidents are greatest among poor, black males. Regional differences are also significant, with escalating violence in the Northeast Region and a downward trend in the Southeast Region².

This knowledge is only possible thanks to the existence of mortality statistics. Death is studied not to ascertain how many people have died, but, principally, to understand the epidemiological and social characteristics associated with this phenomenon³. Thus, mortality statistics are an essential tool for understanding the most important factors affecting the health of a population and informing health policy planning and management^{4,5}.

Mortality data in Brazil is provided by the Mortality Information System (*Sistema de Informação sobre Mortalidade- SIM*), which was conceived and implemented in the 1970s. The basic document used to feed the SIM is the death certificate⁶, which must be emitted for all deaths and completed by a registered medical practitioner, who must verify, certify and state the cause of death³. The legislation is clear with regard to the medical practitioner's ethical and legal responsibilities when it comes to completing the death certificate, stating that he/she should provide truthful, comprehensive and faithful information⁶. In the case of violent death, the body should be referred to the nearest Legal Medical Institute (*Instituto Médico Legal- IML*) for examination by a coroner and to ascertain the primary cause leading to death⁵.

The SIM is a nationwide database and is therefore a powerful tool for assisting public health planning and prioritizing actions, and evaluating public health interventions. However, despite the importance of this database, the SIM still has a number of weaknesses that affect the quality of data that stem from poor-quality death certification, including flaws in stating the underlying cause of death and high rates of incomplete information and omissions⁷⁻¹⁰.

The completeness of death certificates is of utmost importance since they are a source of essential information about the factors and variables associated with death¹¹. Completeness is understood as the extent to which the records of an information system contain non-null val-

ues^{7,12}. In the case of death certificates, completeness is assessed based on the proportion of incomplete and unknown fields in the certificate. In Brazil however, although SIM data completeness rates have improved, the level of incomplete or unknown fields remains high^{1,8}.

The correct definition of cause of death is another important variable affecting the quality of the data contained in the SIM. This aspect is of utmost importance, principally because this data is used to guide public policy. The definition of cause of death must follow the Tenth Revision of the International Classification of Diseases (ICD-10), the global standard for reporting causes of death produced by the World Health Organization (WHO)¹³. Apart from specifying codes for reporting and categorizing diseases, health-related conditions and external causes of disease and injury, this classification also establishes rules for specifying the underlying cause of death, thus standardizing classifications and allowing comparability of data¹⁴.

Despite the ICD, reporting of underlying cause of death remains a concern when it comes to the production of accurate mortality statistics in Brazil^{5,6,9} and other countries^{15,16}. For deaths in general, the most common problem is the use of vague terms, such as cardiopulmonary arrest and multiple organ failure, which do not show the true cause, but rather symptoms and conditions associated with the death^{10,17}. With regard to violent death, the underlying cause should refer to the circumstances of the accident/act of violence that led to the injury^{18,19}. One of the main problems related to the reporting of deaths due to external causes is that coroners often register the nature of the injury, such as fracture, hemorrhage, or perforation, rather than the circumstance^{3,5}.

Therefore, incompleteness and inconsistencies in defining the underlying cause of death can lead to false diagnoses of the state of health of a population and compromise health planning and interventions⁴. A systematic review of methods used for assessing the completeness of data contained in the health information system conducted by Correia et al.⁷ concluded that, despite growing interest, the number of studies of completeness of data in Brazil remains small, especially of studies evaluating primary data sources such as death certificates.

Furthermore, studies addressing quality of data are particularly rare in the country's North and Northeast regions, despite the fact that problems with the SIS in these regions are greater than in the South and Southeast Regions.

In Fortaleza, capital city of the State of Ceará in the Northeast of Brazil, police authorities refer all deaths due to external causes to the Ceará Forensic Institute (*Instituto de Perícia Forense do Ceará*- PEFOCE) for the coroner to perform an autopsy. The coroner issues a death certificate to the municipality's Epidemiological Surveillance Unit (*Célula de Vigilância Epidemiológica da Secretaria Municipal de Saúde de Fortaleza*-CEVE-PI-SMS) where the cause of death is coded and fed into the SIM together with the other information on the form.

The aim of this study is to assess the quality of certification of deaths due to external causes in Fortaleza, based on the analysis of the completeness of the information provided in the death certificate and the concordance between the underlying cause of death stated in the certificate and that registered in the SIM.

Methods

A descriptive analysis was performed of all deaths due to external causes among the population of Fortaleza between January and December 2010 referred to the PEFOCE for autopsy. For this study death due to external causes encompassed the ICD-10 codes V01 to Y36, including homicides, traffic accidents, suicides, events of undetermined intent, legal intervention and other causes of accidental trauma¹³.

In the first phase of the analysis all the death certificates produced by the PEFOCE during the period were identified by consulting the autopsy register book. The original certificates of these deaths were then retrieved from the PEFOCE's files and analyzed one-by-one to assess the quality of death certification.

A total of 2,239 autopsies were carried out at the PEFOCE in 2010, of which 63 were excluded because they were not registered in the SIM. A further 67 certificates were excluded because the official classification of underlying cause did not correspond to the classification adopted in chapter XX of the ICDXX. The final study sample therefore consisted of 2,109 death certificates.

Data was initially collected by reading and registering the information contained in all fields of each death certificate, including alterations, erasures, cross-outs and white-out. The data was recorded using the software EpiInfo for windows version 6.04 (Centers for Disease Control and Prevention, Atlanta, United States).

Information quality was assessed according to the completeness of the birth certificates,

based on the proportion of complete, incomplete and unknown fields and the presence of alterations, erasures, cross-outs and white-out. Quality of certification was classified as following based on the percentage of incomplete fields: excellent (less than 5%); good (5 to 9.99%); fair (10 to 19.99%); bad (20 to 49.99%); and very bad (over 50%)²⁰.

In the second phase, the underlying cause of death described in section VI of the birth certificate (Circumstances and Causes of Death) was blindly coded according to the ICD-10 by an experienced and qualified physician. The code relating to underlying cause of death originally stated on the death certificate was called CID_{PEFOCE}.

The third phase consisted of a search of the official underlying cause of death registered in the SIM (CID_{SMS}) to assess concordance with the underlying cause stated on the original death certificate. Level of concordance was measured by comparing the variable CID_{PEFOCE} and CID_{SMS}. These variables were considered concordant when the first four characters of the CID-10 code were the same, where the first character designates the ICD-10 Chapter, and the remaining digits refer to specified code. Level of concordance was assessed based on a simple Kappa percent agreement with a 95% confidence interval.

The maximum Kappa value is one, which represents complete concordance, while values close to zero and below indicate no concordance, or exactly what would be expected by chance, based on the classification proposed by Pereira²¹: < 0.00 bad; 0.00-0.20 weak; 0.21-0.40 tolerable; 0.41-0.60 fair; 0.61-0.80 good; 0.81-0.90 very good; 1.0 perfect.

The analysis was performed using the software program STATA version 11.1 (2009 – license number 40110591653).

This research project was authorized by the participating organizations (PEFOCE and the city of Fortaleza Health Department and approved by the Research Ethics Committee of the Federal University of Ceará. The researchers met all ethical requirements and ensured confidentiality of the information used in this study.

Results

Table 1 shows the personal information taken from section II of the death certificate. The only field among the sample of 2,109 death certificates with a 100% completion rate was the name of the deceased. Fields with an excellent quality of certification (above 95%) were: type of

death (95.87%); date of death (99.19%); place of birth (99.1%); mother's name (99.62%); date of birth (99.57%); sex (98.76%) and marital status (98.58%). The quality of certification for occupation was good (90.47%). The proportion of incomplete fields was particularly high among four variables: health card (100%); age (46.18%); race/skin color (38.41%), and level of schooling (33.95%).

The fields relating to place of residence and occurrence, sections III and IV of the death certificate respectively, are shown in Table 2. The quality of certification was high for the fields in the residence section, except for zip code, which had a rate of 0.28%. The quality of certification for municipality and state was 100%, followed by street (99.6%), number (94.03%), and neighborhood (96.97%).

With respect to place of occurrence, the proportion of incomplete fields was high for variables except municipality and state, which showed rates of 3.27 and 3.22%, respectively. The quality of certification for establishment, number and zip code were very bad (36.22%, 23.38% and 0.19%, respectively), while the quality of certification for place of occurrence, street and neighborhood were considered bad (55.9%, 61.93% and 66.33%, respectively).

Table 3 shows variables related to deaths among women, medical attention and cause of death. In 206 (78.62%) of the 262 deaths among women, it was not stated whether the death occurred during pregnancy, birth or miscarriage, and in 214 (81.68%) cases whether the death occurred during the puerperium. With regard to medical attention, the proportion of incomplete fields was high for medical attention (64.96%) and whether the diagnosis was confirmed by a complementary examination (83.31%) or surgery (80.18%). In the field that asks whether the diagnosis was confirmed by an autopsy, the proportion of incomplete fields was high (23.14%).

Four lines are provided for cause of death where the sequence of events that led to the death should be outlined, beginning with the most immediate cause on "line a" up to the primary event on the last line. The "line a" had been completed in all certificates. The main causes stated in this field were: traumatic brain injury (16.12%); multiple injuries (9.01%); undetermined (4.32%); mechanical suffocation (3.27%); and hypovolemic shock (2.75%). Various other causes were stated on 64.53% of the certificates. The 'line b' was not filled in 45.19% of the certificates. The most frequently stated causes were: firearm dis-

Table 1. Completeness of information in certificates of deaths due to external causes in Fortaleza, 2010.

Variable	N	%	Alterations/ erasures N (%)
Type of death			10 (0,47)
Fetal	14	0,66	
Non fetal	2.008	95,21	
Incomplete	87	4,13	
Date of death			02 (0,09)
Filled in	2.092	99,19	
Incomplete	17	0,81	
Health card			
Filled in	-	-	
Incomplete	2109	100	
Place of birth			04 (0,19)
Filled in	2090	99,10	
Incomplete	19	0,90	
Name of deceased			18 (0,85)
Filled in	2109	100,00	
Incomplete	-	-	
Father's name			31 (1,47)
Filled in	1.868	88,57	
Incomplete	241	11,43	
Mother's Name			24 (1,14)
Filled in	2101	99,62	
Incomplete	08	0,38	
Date of birth			11 (0,52)
Filled in	2100	99,57	
Incomplete	09	0,43	
Age			6 (0,28)
Filled in	1.135	53,81	
Incomplete	974	46,18	
Sex			13 (0,62)
Male	1.818	86,20	
Female	262	12,42	
Ignored	3	0,14	
Incomplete	26	1,24	
Race/skin color			05 (0,23)
Brown	1.027	48,70	
White	202	9,58	
Black	57	2,70	
Yellow	13	0,61	
Incomplete	810	38,41	
Marital status			12 (0,57)
Single	1.601	75,91	
Married	380	18,02	
Widow	50	2,37	
Separated	45	2,14	
Ignored	2	0,09	
Consensual union	1	0,05	
Incomplete	30	1,42	
Schooling			04 (0,19)
None	71	3,37	
1-3 years	268	12,71	
4-7 years	521	24,70	
8-11 years	230	10,91	
12 or over	154	7,30	
Ignored	149	7,06	
Incomplete	716	33,95	
Occupation			10 (0,47)
Filled in	1908	90,47	
Incomplete	201	9,53	

Table 2. Completeness of information in certificates of deaths due to external causes by place of residence and place of occurrence. Fortaleza, 2010.

Variable	N	%	Alterations/ erasures/ N (%)
Residence			
Street			
Filled in	2.100	99,60	23 (1,09)
Incomplete	9	0,40	
Number			
Filled in	1.983	94,03	8 (0,38)
Incomplete	126	5,97	
Zip Code			
Filled in	06	0,28	-
Incomplete	2.103	99,72	
Neighborhood/District			
Filled in	2.045	96,97	14 (0,66)
Incomplete	64	3,03	
Municipality			
Filled in	2.109	100,00	-
Incomplete	-	-	
State			
Filled in	2.109	100,00	-
Incomplete	-	-	
Incident			
Place of occurrence of death			
Hospital	456	21,62	-
Other health establishment	-	-	
Home	142	6,73	
Public street, road, etc.	535	25,37	
Other	43	2,04	
Ignored	03	0,14	
Incomplete	930	44,10	
Establishment			
Filled in	764	36,22	09 (0,43)
Incomplete	1.345	63,78	
Street			
Filled in	1.306	61,93	12 (0,57)
Incomplete	803	38,07	
Number			
Filled in	493	23,38	02 (0,09)
Incomplete	1.616	76,62	
Zip code			
Filled in	04	0,19	-
Incomplete	2.105	99,81	
Neighborhood/District			
Filled in	1.399	66,33	09 (0,43)
Incomplete	710	33,67	
Municipality			
Filled in	2.040	96,73	03 (0,14)
Incomplete	69	3,27	
State			
Filled in	2.041	96,78	01 (0,05)
Incomplete	68	3,22	

charge (8.82%); blunt object (2.37%); piercing object (2.09%); multiple injuries (1.09%); and

traumatic brain injury (0.75%). Other causes accounted for 39.69% of 'line bs', while 'line c' was not completed in 84.78% of certificates. The two main causes stated on this line were firearm discharge (4.31%) and piercing object (1.81%). The 'line d' was not completed in a remarkable 96.06% of certificates (Table 3).

Section VII of the certificate comprises information on the circumstances of death due to external causes (Table 4). The quality of certification for all the fields of this section were very bad. With respect to type of circumstance of death, the proportion of incomplete fields was 67.76%. The most common causes stated were homicide (19.44%), accident (8.58%) and suicide (1.85%). The proportion of incomplete fields relating to death caused by work accident was 70.27% and this field was answered as *do not know* in 8.3% of cases, while the proportion of incomplete fields for the variable source of information was 69.91%, and the most commonly stated source of information was incident report (27.26%). The proportion of incomplete fields was also high for the summary description of the event and address, whether in a public place, field (81.27% and 96.92%, respectively).

The level of concordance between the underlying cause of death stated on the death certificate and that registered in the SIM is considerably low. For the total sample, the simple concordance rate was 7.49% and the kappa coefficient (0.069) showed poor concordance (IC95% 0,058-0,08). When the deaths were stratified into groups by cause, the concordance rate for accidents was 8.73% and the kappa coefficient was 0.066 (IC95% 0.053-0.079), while that of homicides was 1.33%, with a kappa coefficient of 0.01 (IC95% 0,006-0,017), and that of suicide was 0.88% and 0.002 (IC95% 0,000-0,0062), respectively (Table 5).

The rate of alterations, erasures, cross-outs and white-out was low (under 1.5%) in the majority of the fields, except for the summary description field where the rate was relatively high (18.69%) (Table 4).

Discussion

Mortality statistics are often the main tool for assessing the health status of a given population and for guiding health programs and policies. For this reason, data fidelity is a key element of epidemiology and health planning⁸. The weaknesses in the quality of information contained in

Table 3. Completeness of information in certificates of deaths due to external causes by conditions leading to and cause of death. Fortaleza, 2010.

Variable	N	%	Alterations/ erasures N (%)	Variable	N	%	Alterations/ erasures N (%)
Deaths among women				Cause of death			
Occurred during pregnancy, birth or miscarriage				Line a			
Yes	04	1,53	01 (0,38)	Traumatic brain injury	340	16,12	02 (0,09)
No	35	13,36		Multiple injuries	190	9,01	
Ignored	17	6,49		Undetermined	91	4,32	
Incomplete	206	78,62		Mechanical suffocation	69	3,27	
Occurred during puerperium				Hypovolemic shock			
Yes, up to 42 days				Other causes	1361	64,53	
Yes, from 43 days to one year			-	Incomplete	-	-	
No	25	9,54		Line b			
Ignored	23	8,78		Firearm discharge	186	8,82	02 (0,09)
Incomplete	214	81,68		Blunt instrument	50	2,37	
Medical attention				Piercing object			
Received medical attention during the illness that lead to death				Multiple injuries			
Yes	216	10,24	03 (0,14)	Traumatic brain injury	16	0,75	
No	258	12,23		Other causes	837	39,69	
Ignored	265	12,57		Incomplete	953	45,19	
Incomplete	1370	64,96		Line c			
Diagnosis confirmed by complementary examination				Firearm discharge			
Yes	29	1,38	-	Piercing object	38	1,81	01 (0,04)
No	201	9,53		Puncture wound thorax	17	0,81	
Ignored	122	5,78		Hanging	14	0,66	
Incomplete	1757	83,31		Traffic accident	11	0,52	
Diagnosis confirmed by surgery				Other causes			
Yes	44	2,08	-	Incomplete	1.788	84,78	
No	303	14,37		Line d			
Ignored	71	3,37		Piercing object	27	1,28	-
Incomplete	1691	80,18		Firearm discharge	17	0,81	
Diagnosis confirmed by autopsy				Traffic accident			
Yes	1.600	75,87	02 (0,09)	Other causes	34	1,62	
No	14	0,66		Incomplete	2.026	96,06	
Ignored	07	0,33					
Incomplete	488	23,14					

the SIM are a result of flaws in all stages of the information production cycle, from data generation, to inputting and the final dissemination through data banks⁷. However, studies show that the factor that most influences the quality of SIM data is poor quality death certification^{12,18}.

This study observed a number of major discrepancies when it comes to completeness of birth certificates: the quality of certification for certain fields was excellent, while for many others it was bad or very bad. With respect to personal details, the name of the deceased was the only

field that was completed on all certificates, while for the other fields the quality of certification was good or excellent. Quality of certification was lowest for the fields race/skin color and schooling.

Other studies^{4,12} also found poor quality certification for race/skin color and schooling;

however a downward trend in the proportion of incomplete fields for these variable has been noticed. Macente and Zandonade²² explored completeness of demographic variables sex, age group, race/skin color, schooling, and marital status among deaths due to suicide in the State of Espírito Santo in the Southeast Region of Brazil and in the rest of the country. The lowest quality of certification was found for schooling, with rates of the proportion of incomplete fields varying between 83.8 and 85.5%.

Despite the importance of this data for society, it is apparent that professionals responsible for filling in these forms tend to rank the importance of the categories. This is because the Ministry of Health advocates the classification of information provided on the death certificate into indispensable, compulsory and secondary²³, which contributes towards a culture of poor completion of the fields that are considered "less important", such as race/skin color and schooling⁴.

A number of discrepancies in completeness of data may also be observed for the sections *place of residence* and *place of occurrence*. In the fields in *place of residence* section quality of certification is high, while for those in the *place of occurrence* section, with the exception of municipality and state, quality is bad or very bad. These results differ to the findings of other studies that observed high quality of certification for the *place of occurrence of the death* field^{9,10}, particularly for deaths due to suicide in the State of Bahia where an excellent level of completeness was found in nine years of a ten-year study period¹².

With respect to deaths due to external causes, the high quality of certification for the *place of occurrence* field is to be expected, since bodies are always referred to the IML together with the Police Incident Report (*Registro de Ocorrência Policial- ROP*), which contains the place of occurrence of the incident. Therefore, the low quality

Table 4. Completeness of information in certificates of deaths due to external causes by probable circumstances of non-natural death. Fortaleza, 2010.

Variable	N	%	Alterations/ erasures N (%)
Type			
Accident	181	8,58	02 (0,09)
Suicide	39	1,85	
Homicide	410	19,44	
Other	07	0,33	
Ignored	43	2,04	
Incomplete	1.429	67,76	
Work accident			
Yes	10	0,47	06 (0,28)
No	442	20,96	
Ignored	175	8,30	
Incomplete	1.482	70,27	
Information source			
Incident report	575	27,26	04 (0,19)
Hospital	-	-	
Family	13	0,62	
Other	46	2,18	
Ignored	07	0,33	
Incomplete	1.468	69,61	
Summary description of incident			
Filled in	395	18,73	394 (18,69)
Incomplete	1.714	81,27	
Address, if in public road/street			
Filled in	65	3,08	-
Incomplete	2.044	96,92	

Table 5. Simple concordance between CID_{PEFOCE} and CID_{SIM} and Kappa coefficient of groups of underlying causes. Fortaleza, 2010.

Underlying causes	Simple Concordance (%)	Kappa	IC 95% Kappa	Significance
Homicide	1,33%	0,011	0,0060 - 0,0170	0,0001
Accident	8,73%	0,066	0,0532 - 0,0788	0,0001
Suicide	0,88%	0,002	0,0000 - 0,0062	0,746
Other	25,96%	0,195	0,1750 - 0,2140	0,0001
Total	7,49%	0,069	0,0580 - 0,0800	0,0001

of certification for the fields *place of occurrence* in the death certificates in Fortaleza may be interpreted as a lack of care and attention by coroners when filling out of these forms. Simões and Reichenheim²⁴ suggest that despite the fact that the IML has all the information necessary to ensure the proper completion of death certificates, coroners often fail to make use of all available sources.

The quality of certification of death among women is very bad, with over 80% of the not completed or marked as 'unknown'. In the case of deaths among women of childbearing age, two fields should be filled in that state whether death occurred during pregnancy or puerperium. This information is essential for identifying trends in maternal mortality, especially when external causes are involved. Jorge et al.⁶ highlight that causes of death related to pregnancy, birth and puerperium are among the most poorly recorded in Brazil. In a study exploring deaths due to external causes among women of child bearing age in Recife, Alves et al.²⁵ observed an increase of 36.7% in the Maternal Mortality Ratio. The authors highlighted the need to properly fill out the fields of the death certificate in cases of death among women, affirming that the high rate of incompleteness of these fields has contributed towards the underreporting of maternal mortality in the country.

The present study identified significant flaws in the completion of the fields relating to causes of death, showing that coroners often fail to state a causal sequence of conditions leading to death in the "lines a, b, c and d", which should start with the main disease or condition that led directly to death on the first line, finishing with the main condition that initiated the chain of events leading ultimately to death. Only "line a" was completed in around 55%, while 84% the death certificates were completed up to 'line b'.

Furthermore, practically all the causes stated on the death certificates relate to observed injuries – for example traumatic brain injury, firearm discharge, piercing object – rather than the condition that led to death. As Laureti et al.¹⁴ highlight, the underlying cause of violent death described on the certificate should refer to the circumstances of the accident or act of violence, which are the real underlying causes, and not the type of injury. This concept is grounded in the need for adequate and accurate information to help inform policy planning: it is not the traumatic brain injury, perforation, or suffocation or hemorrhage that is prevented, but rather the homicide, suicide, fall or traffic accident⁶.

The inaccurate definition of the underlying cause of violent death is a persistent problem in Brazil. A study using national SIM data conducted by Jorge et al.³ revealed that the cause of death was not properly stated in a significant proportion of deaths. The results of a study carried out in Belo Horizonte in the State of Minas Gerais that explored underlying causes of death using complementary information from the IML showed a 59.8% reduction of incidents of undetermined intent, a 12.9% increase in suicides, and a 5.6% increase in homicides²⁶. Using complementary information on deaths due to external causes from the press, Villela et al.¹⁹ observed a 220% increase in deaths involving motor vehicles and a 100% increase in motorcycle and bicycle accidents.

Other studies have revealed problems regarding the definition of underlying cause of violent deaths at national level. Although the WHO has established standard rules for specifying the underlying cause de death, problems regarding the identification and coding of the true cause of death persist¹⁴. In France, Lefevre et al.¹⁵ highlight that the main problem in establishing the underlying cause of violent death is inadequate completion of death certificates by coroners. Similar situations were also observed in México²⁷ and in Capetown²⁸.

It is important to note that the quality of mortality statistics in Brazil has improved over the years³. A good example of this is the continual reduction in the proportion of deaths assigned to ill-defined causes²⁹. On the other hand, due regard should be given to the need to improve the quality of data, especially since, although deaths are classified within a general group of causes, the specific causes within the ICD-10 Chapter are often unknown⁹. In fact, a continuous reduction in the proportion of deaths assigned to ill-defined causes can be observed, together with an increase in the proportion of deaths assigned to nonspecific codes included in the ICD Chapters: or, as Jorge et al.³ have confirmed in Brazil, an appreciable proportion of deaths where the cause is coded as ill-defined (nonspecific cause) within a well-defined chapter, despite the possibility of assigning deaths to a well-defined group.

This situation is referred to by the international literature as *garbage coding*³⁰: the utilization of vague terms for defining underlying causes, which provides a poor picture of the real health status of the population and is of little use for guiding the design, implementation and evaluation of health policies. Studies regarding the

Global Burden of Disease^{30,31} confirm a high level of *garbage codes*, particularly in periphery countries and those with poorly developed health systems, thus hindering the comparison of the causes of death between nations.

External causes of deaths of undetermined intent are considered *garbage codes*³¹. The accurate coding of the underlying cause of violent deaths is essential for ascertaining the intentionality of the incident¹⁷. Alazraqui et al.¹ suggest that external causes can be classified according to intentionality: suicide, homicide, accidents and unknown intentionality. Since the latter category includes acts of violence of undetermined intent, which can also encompass suicide, homicide, and accidents, the high proportion of deaths assigned to this category results in a distorted picture of the real underlying causes.

Therefore, although limiting the information on death certificates to the nature of the injury may allow for the classification of the death in Chapter XX of the ICD-10, it does not contribute to ascertaining intentionality and the circumstances leading to the death.

Coding of deaths is carried by qualified technicians at the CEVEPI-SMS who have received training on how to use the standard coding procedures established by the WHO¹⁴. According to Matos et al.²⁶, the coding process and selection of underlying causes of violent incidents is relatively simple when the death certificate provides adequate information for determining the circumstances of death. However, the findings of the present study do not confirm this affirmation. The underlying causes of death most commonly stated on the death certificates were unspecified firearm discharge, undetermined intent and unspecified place, while the most common underlying causes in the SIM were assault by firearm discharge or by unspecified firearm in the street or road. Therefore, the low level of simple concordance between the underlying causes stated in death certificates and in the SIM confirm in adequate specification of underlying causes by coroners working at the PEFOCE.

Lozada et al.¹⁸ highlight that adequate training of coding staff is essential to improve the quality of data provided by the SIM, given that they are responsible for identifying and correcting any distortions found on death certificates. A study conducted in Paraná showed a considerable drop in the proportion of deaths assigned to undetermined intent, as a result of training of coding staff. Other studies^{14,19} have shown the inadequacy of the descriptions of underlying causes

of violent deaths in death certificates filled in by coroners and the need for coding staff to consider complementary information in the IML or in the press.

Despite the importance of the coding process and the possibility of correcting potential mistakes found on death certificates, it should be recognized that the definition of the circumstance of the true underlying cause of violent death is the primary responsibility of the coroner. Therefore, it is clear that the physician should be aware of the importance of the correct and adequate completion of the death certificate for the production of accurate health statistics. However, various studies have revealed that physicians attach little importance to death certificates and that this significantly contributes to the short comings of health statistics^{1,9,17,19}. This lack of commitment may be the result of negligence, ignorance or lack of awareness of the importance of this document for health policy⁴.

Silva et al.¹⁰ affirm that all sections, except Section I, which should be filled out by the registry office, are the legal and ethical responsibility of the physician. However, physicians tend to consider themselves responsible only for filling out the cause of death and pass on the 'less noble' parts to other staff. Matos et al.²⁶ found that one of the functions of administrative staff at the IML is to fill in the majority of information required by the death certificate. This task is delegated not only by coroners, but also by physicians working in public and private hospitals, who pass this task to nurses and other technical staff².

The improvement of death certification, both in terms of completeness of the field and quality of the information on underlying cause, depends principally on training and raising awareness among physicians³³. Various authors have emphasized the flaws in medical school curriculums and the training and development process, meaning that due weight is not given to the importance of these documents and that most physicians do not receive adequate formal training in filling out death certificates properly^{1,7,9,12,14}. It is also important to highlight that there is a need to develop a policy directed at providing continuing nationwide education for IML coroners, rather than isolated and generally ineffective capacity building.

Another important hurdle to the accurate description of underlying causes by coroners is the potential use of this information in legal actions. The fear of legal implications is one of the main reasons stated by physicians for not stating

the circumstances of death on the death certificate, which in turn leads to a high proportion of deaths classified as external causes by unknown intent²⁶. Legal concerns relating to the information contained in the death certificate need to be clarified and effectively resolved in order to prevent medical coroners from being unduly penalized for carrying out their normal functions¹⁸.

This study's findings show that it is necessary and possible to improve the quality of data on deaths due to external causes provided by the SIM based on quality death certification. A number of weaknesses were found related to the low level of completeness of fields that can provide important data for informing health policy and interventions and epidemiological studies. The high proportion of incomplete fields for the variables race/color, schooling, place of occurrence and deaths among women may camouflage the concentration of violent death among groups who are more susceptible and exposed to violence, underestimating the real scope of the social determinants of violence and thus veiling the evidence for the need for intersectoral health policies targeting vulnerable groups.

Apart from problems concerning completeness, this study revealed a number of inconsistencies in the specification of underlying cause of death, which, in the case of violent death, should

always be the circumstance which initiated the chain of events leading ultimately to death. The findings show that physicians tend to state the nature of the injury in the relevant fields rather than the circumstance related to the intentionality of the incident. This practice contributes to the weaknesses of the SIM, since it distorts the conditions related to the death and hinders the proper identification and coding of the underlying cause. This demonstrates a low degree of accuracy and compliance with the official coding recommendations set by the Ministry of Health based on WHO standard procedures.

Finally, this study highlights that the main mechanism for improving the quality of information provided in the medical death certificate is strengthening the commitment of coroners to the effective completion of this document. These health professionals should be made aware of the importance of their work and the information they produce. This calls for commitment from and coordination between medical schools, public health schools, government health departments, institutes of legal medicine, and legal institutions, together with the involvement of other relevant actors, to ensure that coroners receive adequate training in the carrying out of these functions.

Collaborations

KLM Messias participated in study conception, data collection, analysis and interpretation, drafting this article, and in the final approval of the version to be published. JP Bispo Júnior participated in study conception, data analysis and interpretation, drafting this article, and in the final approval of the version to be published. MFQ Pegado, LC Oliveira, TG Peixoto, MAC Sales, MP Monteiro Filho, DG Ferreira, MPF Lage and TP Freitas participated in data collection, analysis and interpretation, and in the final approval of the version to be published. JG Bezerra Filho participated in study conception, data analysis and interpretation, and in the final approval of the version to be published.

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